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Engaging Oncology Nurses in a Primary Prevention Project Related to Radon Exposure:  
Outcome Analysis and Implications for Practice

Systems Change Project  
Submitted in Partial Fulfillment  
of the Requirements for the Degree of  
Doctor of Nursing Practice

St. Catherine University  
St. Paul, Minnesota

Maureen Hynes Quick

December 2013

ST. CATHERINE UNIVERSITY  
ST. PAUL, MINNESOTA

This is to certify that I have examined this  
Doctor of Nursing Practice systems change project  
written by

*Maureen Hynes Quick*

and have found that it is complete and satisfactory in all respects,  
and that any and all revisions required by  
the final examining committee have been made.

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Date

DEPARTMENT OF NURSING

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### **Executive Summary**

The position statement of the Oncology Nursing Society (ONS, 2007) supports the role of oncology nursing in primary prevention stating that specialized educational programs must be developed and provided to practicing nurses in order to facilitate integration of cancer prevention education into clinical practice.

The Radon Education Project (REP) had two aims. First to increase oncology nurses knowledge of the association between radon exposure and lung cancer through an educational program presented to the Metro MN Chapter of ONS and evaluated by an online survey. The second aim was to identify how primary prevention strategies related to radon exposure might be incorporated into oncology clinical practice. In follow up focus groups oncology nurses who had attended the educational program created a list of recommendations for this purpose. In addition, findings from focus groups were used to develop a white paper for the Metro MN Chapter of ONS.

Project objectives were developed in collaboration with the Minnesota Department of Health (MDH) Indoor Air Unit. This is the first documented initiative where oncology nurses have partnered with a state department of health in a formalized, programmatic approach to radon education. Engaging oncology nurses in a project that focuses on primary prevention of radon exposure via an educational program and follow up focus groups yielded new insights for future radon education. Oncology nurse were able to identify programmatic and prescriptive strategies for incorporating primary prevention education on radon into clinical practice and to the broader community.

Results of the online survey following the educational program suggest that oncology nurses find education on the association between radon exposure and lung cancer as highly

relevant to them both personally and professionally. Follow up focus group participants identified that education for nurses and physicians as well as easily accessible information on radon in clinical practice were paramount to educating the patient and family. The timing of instruction should be assessed by the health care practitioner and individualized based on readiness to learn. Some patients may inquire about potential causation for cancer and are ready for education early on while others may be overwhelmed by the diagnosis and treatment requiring delayed education.

Focus group participants recommended that ONS should endorse this work and that patient education could be strengthened by forming partnerships with community, primary care and other organizations. Finally, oncology nurses recognize that homes where tests reveal high levels of radon should be mitigated by professionals to reduce exposure to this hazardous gas. However, the cost associated with mitigation was identified as a potential barrier to education. A white paper, developed through the REP initiative, was presented and adopted by the Metro MN Chapter of ONS and is housed on the chapter website.

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## **Chapter 1**

This chapter describes the health hazard associated with indoor radon exposure and the partnerships that could raise awareness and education. The MDH Indoor Air Unit is dedicated to primary prevention related to radon exposure. Oncology nurses understand the burden of cancer and the need for prevention and early detection measures. In collaboration with the MDH, oncology nurses are well suited to provide radon awareness education to patients and families in the clinical setting.

### **Lung Cancer**

#### **Radon Exposure as a Risk Factor**

Lung cancer death associated with indoor radon exposure is well documented in the scientific literature. Despite this data, the United States has not yet achieved the level of voluntary action required to make a real impact on indoor radon exposure (Environmental Protection Agency [EPA], 2011). Therefore, new avenues are needed to educate the public.

Approximately 15% of all lung cancers are attributable to indoor radon. Radon gas is the second leading cause of lung cancer and the primary risk factor for non smokers in the US with an estimate of 21,000 deaths annually (MDH, 2013; University of Minnesota, 2011). Radon is a naturally occurring gas produced from the decay of uranium that is found in nearly all soil (MDH, 2010). Radon is chemically inert. However, the radon atoms can spontaneously decay or change into other atoms called radon progeny. The radon progeny are electrically charged and can attach themselves to small dust particles. The dust particles can easily be inhaled into the lung. The deposited atoms emit alpha radiation that can disrupt DNA of the lung cells leading to one step in the development of lung cancer (National Research Council, 1999).



Radon flows from the soil into the air. Outside air typically has low concentrations; however, radon gas can also seep into homes where it is unable to disperse. This build up of radon gas within the home can then lead to higher concentrations in the air (National Research Council, 1999). Since radon gas is clear and odorless, individuals may be unaware of their exposure to this harmful gas. Nationally elevated radon levels are in as many as one in 15 homes (EPA, 2013). In some states the average number of homes with radon levels above the EPA action level of 4 pCi/L is much higher. In Minnesota two in five homes have radon levels that pose a significant health risk where the geology produces an ongoing supply of radon and the climate affects how homes are built and operate (MDH, 2013).

The death risk to the average person from radon gas at home is 1,000 times higher than the risk from any other carcinogen or toxin regulated by the FDA or EPA (University of Minnesota, 2011). On the basis of epidemiologic studies of underground miners, the Committee on Health Risks Exposure to Radon concluded that exposure to radon in homes is expected to cause lung cancer in the general population (National Research Council, 1999). Although radon is a ubiquitous, naturally occurring substance, the buildup of radon in indoor air can exceed EPA guidelines. Given the health hazard associated with exposure to indoor radon, there is a need to increase the knowledge of health care professionals so that they are competent and confident to educate the public about radon and to promote testing and mitigation of residential homes.

### **Smoking as a Risk Factor**

Smokers have a 20 fold increase risk of developing lung cancer when compared to never-smokers, with 85-90% of all lung cancer being directly linked to tobacco exposure; however, only 15% of heavy smokers develop lung cancer (Yoder, 2006). Work has been done to inform the public of the hazards of smoking, but what may be less understood by the general public is

that smokers can have an enhanced carcinogenic effect from exposure to cigarette smoke and radon. The combined effect of smoking and radon exposure is synergistic; therefore at equivalent exposure to radon, smokers will have a higher risk of developing lung cancer than non smokers (Copes & Scott, 2007). Carcinogenesis is a complicated process that is caused by DNA damage. Genetic polymorphisms that cause carcinogens to accumulate in any individual are highly suspect in contributing to the development of lung cancer (Yoder, 2006). Clearly smoking, with or without radon exposure, is a critical issue in preventing lung cancer.

### **Project Partnerships**

#### **Oncology Nurses**

Oncology nurses understand the painful implications of a cancer diagnosis for the patient and family. This unique perspective coupled with the relationship that oncology nurses have with their patients may yield additional opportunities for education on radon in the clinical setting. Public health agencies focus on reducing the burden of cancer and improving population health. Health care delivery organizations and clinicians could partner with public health agencies to coordinate prevention and health promotion interventions to improve health outcomes (Institute of Medicine [IOM], 2012). Oncology nurses may be additive to the ongoing effort by governmental agencies in educating patients on the risk of lung cancer associated with radon and in encouraging testing and potential mitigation of their homes.

Oncology nurses in clinical practice generally focus on the care of the cancer patient throughout the trajectory of the disease. This includes administering therapeutic interventions such as education, support, chemotherapy and palliative care. Although risk factors may be assessed by the oncology nurse, the focus is on the care and management of patients with disease and not on the prevention of disease.

A cancer diagnosis is often challenging for the patient and oncology nurses know well their pain and suffering. The goal of oncology nursing is to effectively care for patients living the cancer experience. In addition to the patient, the family is viewed as integral to the overall plan of care. Oncology nurses often develop long term relationships with patients and their family members as many types of cancer are now considered a chronic disease requiring intermittent or continuous treatment for months and sometimes years. These long term relationships provide opportunities to establish a high level of trust between the nurse and patient and their family. The oncology nurse may be seen by the patient and family as a source of health information beyond the immediate scope of the treatment plan.

Although oncology nurses typically work in a variety of roles in tertiary care, most are aware of risk factors that lead to the development of cancer and the importance of early detection to improve outcomes. For instance, knowing the association between smoking and the development of lung cancer, oncology nurse often assess patients for a smoking history during clinic visits and can advocate for patients and family members to participate in smoking cessation programs. This general understanding of the principles of risk reduction through primary and secondary prevention for cancer could guide behaviors; like radon testing and mitigation, applicable to themselves and to patients and their families. However, currently nurses identify that health care practitioners need to be educated on the association of radon to lung cancer in order to educate patients and advocate intervention.

Oncology Nursing Society is a national organization of oncology nurses whose mission is dedicated to promoting excellence in oncology nursing and quality cancer care (ONS, 2011). The national organization was founded in 1975 and has grown to over 35,000 members, 231 chapters and 27 special interest groups (ONS, 2011). It has four local chapters in Minnesota.

The largest chapter, Metro MN ONS, draws its membership from the Minneapolis/St. Paul area. The Metro MN chapter has over 200 members and hosts monthly meetings most of the year to offer continuing education and networking opportunities.

In addition, ONS supports oncology nurses work in the area of primary prevention. In their organizational position statement it acknowledges that oncology nurses can develop, implement and evaluate measures to ensure that individuals and families have access to education about cancer prevention and appropriate cancer screening (ONS, 2007). The position statement supports primary prevention strategies in general, but is not specific in the area of radon and does not provide specific education or support to prepare practitioners to educate patients and their families on radon and lung cancer.

### **Minnesota Department of Health and Minnesota Cancer Alliance**

Organizations that focus on radon in Minnesota collaborated with Metro MN ONS in implementing the REP. The MDH received the State Indoor Radon Grant from the federal government for the purpose of protecting the health of the public from the risks of radon related lung cancer (MDH, 2010). The Minnesota Cancer Alliance (MCA) is a broad coalition of organizations and leaders from diverse backgrounds and disciplines dedicated to reducing the burden of cancer across the continuum from prevention to end-of-life care (MCA, 2013). In response to this charge, they developed a five year plan. Cancer Plan Minnesota 2011-2016 is a framework for action created by the partners of the MCA (2011) to address the burden of cancer in Minnesota. One area for intervention identified in the framework is to educate stakeholders about radon safety. The medical community has been one partner targeted for education on the health risks of radon and how to effectively communicate these facts to patients (MDH, 2010).

These organizations have a joint goal to reduce radon indoor exposure to Minnesota residents. This ideally would be achieved if all residents of Minnesota tested their homes for radon and mitigated their homes if the test revealed high levels of radon (MDH, 2010). This goal is difficult to achieve and requires statewide policy and education to legislators, home builders, real estate agents and associated nonprofit agencies (MCA, 2013). Additional strategies include educating stakeholders, legislators, home builders, and real estate agents and associated nonprofit agencies about radon safety (MCA, 2011). Their ongoing efforts to reduce radon exposure in Minnesota and their community partnerships with other stakeholders interested in this issue made for an ideal partnership for implementation of the REP.

### **Problem Statement**

Although there have been advances in the treatment of lung cancer, this is still a diagnosis with very serious morbidity and mortality (Copes & Scott, 2007). Statistical endpoints in clinical anticancer drug trials have focused on progression free survival and overall survival. Progression free survival is the time a patient may live without progression of objective signs or subjective symptoms of the malignancy, whereas overall survival is the date of death in the clinical trial (Markman, 2009). In recent years, medical advances have helped to improve progression free and overall survival in a variety of cancers. Despite the advances in some cancers, the mortality rate for lung cancer remains dismal. According to the American Cancer Society (ACS, 2013), lung cancer accounts for more deaths than any other cancer in both men and women with an estimated 156,940 deaths; accounting for about 27% of all cancer deaths this year.

Clearly the burden of lung cancer is a major public health problem nationally. In Minnesota, the risk of radon induced lung cancer is higher than the national average and

measures could be adopted to reduce radon related lung cancer. Radon control policies should be evaluated using methods routinely applied to other health interventions (Gray, Read, McGale & Darby, 2009). Members of the general public and some public health officials have been slow to take action to decrease radon exposures in the United States. Among the reasons for this inaction is a failure to appreciate the magnitude of the risk that radon can pose in some regions and the potential to avoid lung cancers through an aggressive regulatory policy of radon mitigation (Steck, 2010).

### **Radon Education by Oncology Nurses**

The treatment paradigm for lung cancer usually results in poor outcomes so the focus of care often moves to quality of life issues. During the trajectory of the disease the family often becomes an integral part of the overall plan of care. Family members who live in the same residence may also be at risk for developing lung cancer if the radon levels in the home are high. The long term relationship that oncology nurses develop with patients and families may be ideal for educating a potentially motivated group. Therefore, an effective partnership with advocacy groups, MDH and oncology nurses on radon safety education has potential for success.

The ONS supports oncology nurses involvement in primary prevention initiatives and oncology nurses recognize the need for preventative strategies given the poor clinical outcomes observed in lung cancer. Oncology nurses share the same goal as the MDH and the MCA and may be motivated to take action in primary prevention strategies due to their world view. Oncology nurses are interested in reducing their own risk of developing cancer and reducing the risk to family and friends.

The purpose of the REP was to evaluate knowledge and perception of the relationship between lung cancer and radon exposure among the nurses who belonged to the Metro MN

Chapter of ONS and to identify how oncology nurses might incorporate radon safety education into clinical practice. If successful, this project could serve as a model for organizing other alliances in these efforts locally and nationally. The focus group recommendations for integrating primary prevention into practice have the potential to advance the role of the oncology nurse in the area of radon exposure and risk reduction.

### **Radon and Health Disparity**

There is sound scientific evidence that demonstrates the association between indoor radon exposure and lung cancer. Despite this compelling data, there are fundamental and interrelated barriers that prevent widespread, voluntary radon risk reduction including limited public understanding of the gravity of the risk and perceived high costs of radon mitigation (EPA, 2011). Opportunities to increase testing and mitigation exist that include demonstrating the importance of radon testing and mitigation and providing direct support to reduce the risk for those who lack sufficient resources (EPA, 2011).

This project targeted education to oncology nurses who can inform patients and potentially the larger community. This is an important first step. Education, especially of health care professionals, can lead to advocacy for policy that will dedicate financial resources for universal radon testing and mitigation for all communities. This is a social justice issue as it stands to reason that many low and middle income Americans would not be able to afford radon mitigation if they owned a home. Larsson, Hill, Odom-Maryon and Yu (2009) reported that protective behaviors related to reduction of harmful exposures in the home environment are largely the domain of homeowners. Their findings show that people who occupy single family homes/townhomes were more than twice as likely as people who occupy apartments/condominiums to have heard of radon. In addition, there is virtually nothing a renter

can do to limit exposure to high radon levels and there are no known requirements or incentives for landlords to test or mitigate (EPA, 2011).

Payne-Sturges and Gee (2006) reported that health disparities are partially driven by differential access to resources and exposures to hazards. Factors such as smoking and environmental conditions can also lead to greater risk exposure to individuals in poor communities that disproportionately includes minority populations. Payne-Sturges and Gee (2006) noted that racial groups differ in health outcomes because of greater exposure to illness risk factors and they are more likely to encounter high-poverty neighborhoods and employment in more hazardous occupations. According to the EPA (2011), few homes, schools and daycare facilities are tested for radon and even smaller number are mitigated when high radon levels are found. In addition, without financial assistance, many low income Americans do not have the financial resources to mitigate high radon levels.

Sorting out causality in this complicated area is as difficult as understanding multi factorial contribution to carcinogenesis. Despite this challenge, it is important to appreciate that lung cancer is linked to exposure to radon and smoking, but the combined exposure enhances the risk of lung cancer (National Research Council, 1999). The role of social disparity and how exposure to multiple hazardous environmental toxins may contribute to the development of radon induced lung cancer is unknown. What is known is that the poor and underserved remain at risk and deserve to have information and advocacy in the area of radon induced lung cancer.

### **Project Objectives**

The purpose of the REP was to educate and develop recommendations for a primary prevention strategies related to radon for oncology nurses in the Metro MN Chapter of ONS. This was accomplished through an educational program for oncology nurses focused on



increasing knowledge of the association of radon and lung cancer. This program was evaluated by an online survey. Several months after attending the educational program, participants were invited to follow up focus groups to identify how primary prevention strategies related to radon exposure might be incorporated into oncology clinical practice.

There is clear scientific evidence that radon is associated with thousands of lung cancer deaths per year (MDH, 2013; University of Minnesota, 2011). Despite this scientific knowledge, current strategies around radon education for testing and potential mitigation fall short of the goal to test every home. Change is needed to effectively disseminate this important message to the general population. Health care practitioners could be mobilized to understand the scope of the problem and recruited toward action. Oncology nurses, in particular, are well equipped to partner with departments of health and other public health agencies and alliances in addressing radon education.

## **Chapter 2**

This chapter reviews the theoretical framework and literature review that supports the REP. Oncology nurses were selected as participants in the REP based on the assumption that they would support primary prevention work in radon education as described in Pender's Health Promotion Model. The scientific evidence to support the causal relationship between radon and lung cancer has been well described. Therefore, the REP was not designed to add to the scientific knowledge, but sought to explore perceptions and knowledge related to radon and lung cancer. The literature review focused on perceptions of radon risk in populations and sociodemographic correlates to radon testing and mitigation behaviors. Information that could yield new insights into testing behaviors or barriers to testing was of interest.

### **Theoretical Framework**

Pender's Health Promotion Model was selected as the theoretical model because it focuses on prevention of disease. Oncology nurses are aware of the poor outcomes associated with the treatment of lung cancer and are motivated to use cancer prevention strategies that they find meaningful. In addition, the model is positive and identifies variables that lead to a commitment and to a plan of action. Four main assumptions and thirteen statements define the model (Nursing Theory, 2013). Two assumptions that define this project are as follows: 1) "health professionals, such as nurses, constitute a part of the interpersonal environment, which exerts influence on people through their life span;" and 2) "persons commit to engaging in behaviors from which they anticipate deriving personally valued benefits" (Nursing Theory, 2013). Oncology nurses are aware of the poor outcomes associated with the treatment of lung cancer and they can commit to behaviors (cancer prevention strategies) that they value and find meaningful. They are also part of a supportive network that will reinforce commitment to a plan

of action (shared beliefs). This commitment to a plan has potential to influence health promoting behaviors.

### **Literature Review**

The literature demonstrates strong epidemiologic evidence to support the causal association between radon and lung cancer (Sethi, El-Ghamry & Kloecker, 2012). Although the early work in residential radon was extrapolated from epidemiologic studies with minors, the body of scientific literature through cohort studies and pooled studies continues to support these earlier conclusions. Pooled results from case-control studies demonstrate increase incidence of rates of lung cancer related to residential radon exposure at levels of 2.7 pCi/L (Sethi et al., 2012).

Given the evidence of the health hazard associated with exposure to indoor radon, there is a surprising paucity of nursing research on this topic. The primary purpose of this literature review was to find publications that address education, perception of radon as a health risk and testing behaviors. The literature review was done using the following electronic databases: CINAHL, Pubmed and Medline, and Science Direct. Search terms of *oncology nursing*, *lung cancer* and *education* were used. Since radon has been extensively studied for years, the majority of publications found describe the basic science. Using the MeSH term *education* and *lung neoplasm* and *radon* with the qualifier of *prevention/control* yielded five results. These terms were a bit narrow and did not relate to education or respondent perception of radon. Literature that did not address education or radon risk perception was omitted. An attempt was made to limit the search to the last five years; however, this yielded very low results. Despite a broader search, primary research in the area of radon perception and education was limited.

The studies of interest were primarily descriptive from the area of environment health, public health nursing and departments of health. Most of the research correlated with radon perception to demographic data, testing behaviors and, importantly, to smoking.

A literature search was conducted to gather data on perceptions of radon as a health hazard and related sociodemographic correlates to radon testing and mitigation behaviors. This data could be used to tailor future use of the REP, guide general health education strategies or identify gaps needed for further research. Six research studies focused on radon risk perceptions and testing behaviors related to: gender and age, smoking, education, household income and home ownership.

### **Radon Health Risk Perception and Related Correlates to Radon Testing and Mitigation**

**Gender and age.** Overall perception of radon exposure as a potentially serious health risk was reported as low by several studies (Duckworth, Frank-Stromborg, Oleckno, Duffy, & Burns, 2002; Halpern, & Warner, 1994; Hill, Butterfield, & Larsson, 2006). In addition, a knowledge deficit of the association of radon to specific health effects was reported. Further, women were found to be more interested in radon testing and tended to view radon as a health risk. The targeted sample in Duckworth et al. (2002) was from randomly selected households that would be interested in participating in a survey because of the incentive of free radon testing. The sampling procedure may explain the results toward individuals more interested in radon testing as women made up 77% of the sample in this study. The investigators also noted that participants were unsure as to the specific health risk of radon. This may account for why the majority of respondents had never before tested for radon.

In the early work by Halpern and Warner (1994), radon risk perception and sociodemographic characteristics were described in 41,104 individuals who were surveyed on a

wide range of health beliefs. A belief in an effect from radon that was not supported in the scientific literature was labeled as a “false effect.” They reported that more women believed in false effects from radon exposure (Halpern & Warner, 1994). The researchers used multiple logistic regression analysis to examine the relationships between respondent characteristics and knowledge and action related to radon. This analysis seems appropriate given the review of multiple independent variables on health beliefs. Less than one third of respondents’ believed that radon causes lung cancer.

Although data are limited, more variability was observed within the studies related to age and radon perception or testing and mitigation behaviors. In general, younger people were more willing to test for radon and were more concerned about associated health risks (Duckworth, 2002; Halpern, 1994; Denman et al., 2009). In one study, (Halpern & Warner, 1994), no differences were noted on younger or older respondents in overall knowledge; however, older respondents were less likely to test or plan to test. In Duckworth et al. (2002), older groups were less likely to perceive radon as a serious risk than younger groups. A significant association was found between perceiving radon as a serious health hazard and planning to test for radon, but there was no association between perception of the health risk and plans to reduce radon. Denman et al. (2009) studied two groups in a campaign to reduce smoking and radon: one group remediated their homes of radon and the other group quit smoking. Remediators tended to be older than quitters, but that difference did not reach statistical significance. It is interesting to note that quitters were also more likely to have been in their current house for a shorter time than both remediators and the national population ( $p=0.036$  and  $p=0.033$  respectively). It would seem plausible that this difference could be related to age, but difference of age between the groups did not reach statistical significance.

**Radon and smoking.** Radon testing and mitigation behavior in smokers tended to mirror the general population, but the findings showed some variability (Denman, 2009; Halpern, 1994; Lichtenstein et al., 2007; Riesenfeld et al., 2007). Denman et al. (2009) reported statistically significant demographic differences between the remediators, quitters and the general population. Of note, quitters regarded the direct health concerns as a major decision factor to quit smoking over radon indicating limited knowledge as to the risks of radon exposure. Although the data were limited to one study, the investigators demonstrated a valuable point in targeting smoking cessation groups. Smokers are at increased relative risk to develop lung cancer related to the synergy of radon and smoking (Copes & Scott, 2007). In this study, the respondents' were motivated by the direct health effects of smoking and have young children in the home. This difference could be used to target interventions in this specific population at risk (Denman, 2009).

Other investigators found no differences in testing or mitigation behaviors for smokers. This may be related to the tendency for smokers to have poor preventative health behaviors in general (Halpern & Warner, 1994). This is a disturbing finding given the synergy of smoking and radon exposure already discussed and highlighted as an important in Riesenfeld et al. (2007). Their research focused on the population of individuals with high radon levels above the EPA action level and found no association between radon mitigation and smoking.

One study demonstrates the potential success of combining anti smoking initiatives with radon education. Lichtenstein and colleagues (2007) reported on an interventional study with telephone counseling and targeted video on smoking cessation. Households which received the combination of both counseling and targeted video were more likely to institute new bans on smoking in the home ( $p < 0.03$ ). New bans were associated with quitting smoking and the

presence of children in the household. Radon education was part of both interventions with focus on increase health risk of radon exposure and smoking. Radon mitigation behaviors were influenced by both interventions.

In analyzing the demographics of the study, the groups were well balanced (Lichtenstein et al., 2007). Given the large sample size, 1364, only 63 homes had radon test levels at or above the EPA threshold for considering home remediation (4 pCi/l). This is lower than what would be expected from the national average of 1 in 15 homes. A limitation of the study was the number of homes with high radon levels were small compared to the general population, but the results are still clinically meaningful. The combined intervention led to increased smoking bans and mitigation by participants. This was also important since the presence of children in the home was also associated with quitting smoking and establishing new bans. Although the data are limited, this study provides insight to a combined educational approach. This study may help educators who are skeptical that this approach may dilute the anti smoking message.

**Radon and education.** Additional demographic data on the impact of education to radon perception, testing and mitigation behaviors also varied (Denman, 2009; Hill, 2006; Halpern, 1994; Riesenfeld, 2007). In addition, higher education demonstrated a trend toward increased radon testing, but was not statistically significant. Hill et al. (2006) also noted that knowledge and education were not reliably associated with home testing, although the correlations were evident in some cases. This study of 31 rural households of primarily Caucasian (97%) individuals was small and, therefore, not generalizable. However, it provides information related to perceptions of risk of radon exposure living in a rural community. The majority (52%) of the sample stated that they were unsure, to some extent, that radon could cause health problems (Hill et al., 2006). Further research in this population is warranted.

Riesenfeld et al. (2007) reported that education, concern over real estate value and living in the home less than 10 years old were factors associated with mitigation. Respondents with a college degree were three times more likely to mitigate (OR 3.05 CI=1.2-7.6) ( $p=0.021$ ). The use of the multivariate stepwise logistic regression model seems appropriate for this analysis because the investigator was trying to explore relationships between multiple variables to see what variable was the strongest predictor.

**Radon and household income.** Data were limited, but correlating radon testing and mitigation behaviors to household income, demonstrate an increase in testing but not mitigation (Hill, 2006; Halpern, 1994; Riesenfeld, 2007). In Halpern and Warner, (1994) respondents with higher family income were associated with greater knowledge regarding radon and testing behaviors. The authors' note that this finding was not unexpected, since those with higher incomes possess the economic means to mitigate if high levels of radon are found in their homes. However, there was no report on mitigation from those with higher incomes. In Hill et al, (2006), positive associations were observed between radon testing and both household income ( $r=.373$ ,  $p < .05$ ) and home ownership ( $r=.474$ ,  $p < .01$ ). Moreover, of the 10 households with radon levels above the EPA action level of 4 pCi/l, results were equally divided with respondents who perceive any risk or no risk for exposure. Data from this small study demonstrates that there was an association with household income to radon testing, despite level of knowledge about radon risk (Hill et al, 2006). In Riesenfeld et al, (2007) analysis of a survey of individuals who had already tested their homes for radon and were known to have elevated levels revealed no association between mitigation and higher income. Although household income was generally associated with increased testing, there were no data discovered in this literature



review that income, regardless of knowledge of radon risk, leads to mitigation behavior for homes testing above the EPA action level.

**Radon and home ownership.** The literature review suggests that the relationship between the demographic variable of home ownership and radon is complicated. This relationship is assessed considering home ownership, time in current house and the age of the home (Denman, 2009; Duckworth, 2002; Hill, 2006; Riesenfeld, 2007). As described earlier, Hill et al. (2006) found a positive association between radon testing and home ownership ( $r=.474$ ,  $p < .01$ ). Duckworth et al. (2002) did not report this correlation. Denman et al. (2009) found that remediators (those who mitigated their home) have been in their home longer than the national average, but this was not statistically significant ( $p=0.110$ ). Whereas quitters, term uses for those who quit smoking, were more likely to have been in their current house for a shorter time than both remediators and the national population ( $p=0.036$ , and  $p=0.033$ , respectively). Riesenfeld et al. (2007) found that mitigation was associated with the age of the dwelling (less than 10 years old). The relationship of home ownership to age of the dwelling and time in the current home needs further exploration.

### **Synthesis from the Review of the Literature**

Given the overwhelming scientific evidence of the association of radon to lung cancer, the literature surprisingly lacks research focused on knowledge and perception related to radon exposure risk. Despite this limitation, the literature review did yield important findings that focus on education, radon risk perception and correlates that may guide nursing radon education. All six studies that address radon perception and sociodemographic correlates demonstrate that a knowledge deficit exists related to radon health risk and that there is a common perception that personal risk associated with radon is low. Demographic data analysis also yielded interesting

but inconsistent findings. From the studies reviewed, knowledge about radon is often superficial and can lead to misconceptions and incorrect conclusions about risk. Although education and household income may lead to greater testing, there is no data to suggest that there is an association with mitigation in homes with high levels of radon. This may also reflect the superficial understanding of the risk associated with radon exposure. The limited research exploring public perception of radon health risk and correlates to behavior related to radon testing and mitigation suggests that this is a topic where nurses are well positioned to take an active role. Education is clearly needed to help achieve a greater understanding of radon health risks in our communities.

### **Radon Education Project: Return on Investment**

So what is the cost benefit of the Radon Education Project? With limited resources, MDH provided the tape recorder and test kits and the costs for the educational program were paid by ONS and food and beverage costs for the focus groups were modest. The radon test kits and laboratory analysis were made available to program participants by MDH.

Although oncology nurses represent a sample of individuals motivated to test their own homes and to share information on radon, it was beyond the scope of this project to evaluate whether patient education in clinical practice will lead to testing and mitigation by patients and their families. MDH views this project positively and they have found this group of health professionals to be particularly engaged in the process. The potential to save lives with this work remains valid and needs further exploration. Given that the project costs were minimal, the cost benefit compared to prevented treatment costs and deaths due to lung cancer is important to investigate in the future.

Based on the theoretical framework, oncology nurses understand the poor outcomes associated with lung cancer and could commit to cancer prevention strategies that they find meaningful. The supportive network within the Metro MN Chapter of ONS can also influence and reinforce this commitment toward health promoting behaviors.

The literature review on radon risk perceptions and knowledge was limited and demographic correlates were variable. Despite this limitation, it was clear that radon risk perception and knowledge of radon exposure to lung cancer development is low in the general population. Based on the theoretical framework and the literature review, oncology nurses would be well suited to hear the message of radon risk and to disseminate this information to others.

### **Chapter 3**

The literature review highlighted the lack of knowledge of radon risk in the general population. Based on this review, the REP included three phases: education to oncology nurses on the risk associated with radon exposure, follow up focus group sessions to seek insight from participant on how radon education for patients can be achieved in the clinical setting and the development of an educational white paper on radon for use by the Metro MN ONS chapter membership.

#### **Project Design and Methodology**

Radon Education Project used a mixed methods design to explore knowledge and perceptions of oncology nurses about radon exposure and lung cancer. The ultimate goal was to identify and recommend strategies for incorporating primary prevention education into clinical practice. The study participants were recruited from members of the Metro MN Chapter of the ONS who attended an inservice at a monthly meeting. The project had three phases. In Phase I, an educational program was developed and presented that met the standards for certified CE programming from the ONS national organization. Some of the attendees at the educational program signed a consent form indicating interest in participating in the next phase of the REP. These individuals completed a post inservice online survey and received free radon kits. In Phase II, the focus groups were designed and offered to individuals who attended the Phase I educational program. Phase III included the development of a white paper on radon and lung cancer which was based on the recommendations gleaned from the focus groups. This paper was presented to the Metro MN ONS Board for adoption (Appendix C).

To safe guard informed consent in this study, an application was submitted for review to the Institutional Review Board (IRB) at St. Catherine University prior to the implementation of

both Phase I(education phase) and Phase II (focus groups) for this study. Consent forms for Phase I and Phase II are found in Appendix A & B.

### **Phase I: Educational Program**

In March 2012, a continuing nursing education activity on radon and lung cancer was approved by ONS, which is an accredited approver through the American Nurses Credentialing Center. The educational activity was presented on April 10, 2012 during the monthly meeting of the Metro MN Chapter of the ONS with a total of 66 members and affiliates in attendance. Of these attendees, 41 Metro MN ONS members signed consent forms (Appendix A) for participation in the radon education study project. Of the 41 who signed consent forms, a total of 33 completed the online survey with the questions found in Table 1.

Table 1

#### Post Radon Education Electronic Survey Questions

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1. What is your practice setting?
  2. What is your highest degree you have received in nursing?
  3. Number of years you have worked in oncology nursing?
  4. Prior to this educational program, have you tested your home for radon?
  5. Prior to this educational program, was your home mitigated for radon?
  6. Did you test your home with the radon test kit provided at the radon educational program at Metro MN ONS?
  7. Did you or are you planning to mitigate your home due to test results?
  8. Did you share information about this program on radon and lung cancer with family and friends?
  9. Was the educational program relevant to you personally?
  10. In what ways do you think you may use the information you learned in the program in your practice?
-

## Phase II: Focus Groups

In the fall of 2012 members of the Metro MN Chapter of ONS who attended the educational program on radon exposure and lung cancer and signed consent forms for participation were invited to attend one of three follow up focus groups. Focus groups were conducted between five to seven months after attending the educational program. Participants included oncology nurses holding various positions (research, management and clinical practice) from five health care institutions within a large metropolitan area.

Each focus group began with a review of relevant information on radon and lung cancer covered in the educational inservice in April as well as a short discussion on the key findings from the online survey. Participants were provided with the ONS definition for primary prevention: Primary cancer prevention refers to the prevention of cancer through health promotion and risk reduction (ONS, 2013). Open ended questions were utilized to elicit possible ways that radon education might be incorporated into clinical practice (Table 2).

Table 2:

### Focus Group Questions

- 
1. Now that we just recapped information on radon and lung cancer, tell us why you attended the program?
  2. Tell me how primary cancer prevention compares to your current role in oncology clinical practice? (To clarify also do you utilize health promotion or risk reduction activities currently in your work?)
  3. Talk about specific ways that radon and lung cancer education testing and mitigation can be done in clinical practice? (To clarify, how can it be accomplished? Any specific time point in the trajectory of the disease that you feel will be more relevant for primary cancer prevention?)
  4. Tell me a little about what may be potential challenges to bringing forth this information to oncology patients and educating cancer patients and their families?
  5. What do you feel are the necessary components in developing a position paper or white paper for Metro MN on radon and lung cancer education?
    - a. Consider the role of the oncology nurse?

- b. General or specific components?
  - c. What should be included?
  - d. What steps are required?
  - e. The position of the Metro MN ONS on radon and lung cancer education in oncology clinical practice is.....?
- 

### **Implementation of the Project**

For the educational component of the REP, a date was selected to present the inservice in collaboration with the Metro MN Chapter of ONS. Survey data were collected via electronic survey and the results and percent of test kits returned by program participants were verified through the laboratory by January 31, 2013. The radon education and follow up focus groups were completed in the fall of 2012. The focus group recommendations for a white paper to the Metro MN ONS were delivered to the board on September 10, 2013 and was adopted and placed on the ONS Metro MN Chapter website.

The REP aligns well with the position of ONS on cancer prevention and was readily embraced by the local chapter. The need for education and the underappreciated hazard of radon was well described in the literature. The objectives of the REP attempted to address this gap.

## **Chapter 4**

This chapter will review the data analysis for the three phases of REP. This will include information from the online survey, identified themes from the focus groups and discussion on the development of the white paper.

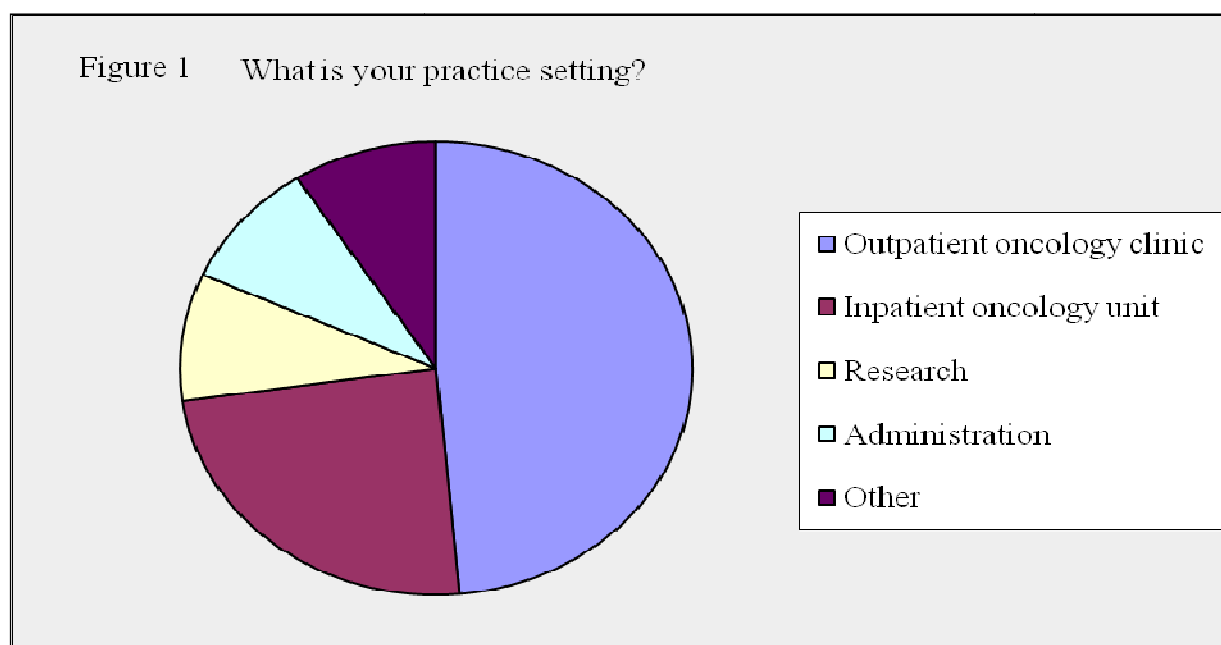
### **Data Analysis**

#### **Phase I**

**Online survey.** Data collection of the Phase I educational program was done via an electronic survey. Survey questions were constructed to assess learning, motivation to complete radon testing and mitigation if indicated, and to assess study participants interest in sharing radon safety information with family, friends or patients.

In Phase I, a total of 41 Metro MN ONS members signed consent forms with 33 of them completing the online survey. Summary of the survey revealed that study participants worked primarily in the outpatient setting and represent oncology nurses from five health care institutions within a large metropolitan area. Participants worked in a variety of oncology roles including research, clinical practice, nurse practitioner, clinical nurse specialist, clinical coordinator and hospice nurse (Figure 1). Other demographic data were also collected (Table 3 and Table 4). The majority of nurses had a Bachelor of Science in Nursing (BSN) degree and worked for more than 20 years in oncology nursing.





**Table 3.** Highest Degree Received in Nursing

Answer Options	Response Percent	Response Count
AD	9.1%	3
Diploma	3.0%	1
BSN	66.7%	22
MSN	12.1%	4
DNP	3.0%	1
Other	6.1%	2
Answered questions 33		

**Table 4.** Number of Years in Oncology Nursing

Answer Options	Response Percent	Response Count
1-4 years	6.3%	2

5-10 years	9.4%	3
11-20 years	18.8%	6
More than 20 years	65.6%	21

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Answered questions 32

**Survey content items.** Responses to content items indicated that 46% tested their home for radon prior to the educational program and that 46% also tested with the radon test kit provided at the Metro MN ONS meeting. In addition, 94% shared the information on radon and lung cancer with family or friends and 100% stated that the information was relevant to them personally and the majority identified applicability to clinical practice. Survey comments were generally positive and demonstrated interest and the importance of radon testing and mitigation.

**Radon kits.** In addition, a quantitative assessment was completed on actual radon testing done by participants. A number was assigned to the test kit and the laboratory sent the radon test result using the number and not the participant name. Utilization of the radon kits and responses to the survey were summarized (Table 5). Radon test kits offered at the conclusion of the program and laboratory results were tabulated. A total of 49 participants used the radon test kit provided at the program. Six test kits were inevaluable. Radon test levels ranged from 0.7 -18.3. A total of 12 tests out of 43 evaluable results (28%) exceed the EPA action level of 4Pci/L. These results were better compared to the Minnesota Department of Health data that states that two in five homes (40%) have radon levels that are rated high radon zones (MDH, 2013). This may be related to the high testing already done by participants prior to the inservice. Survey results showed that 46% of the project participants had tested their homes for radon prior to the program.

**Table 5.** Radon Test Kit Results

Test Kits Used	Prior Testing	Inevaluable Tests	Test Level Range	% Above EPA Action Level	% MN Homes Above EPA Action Level
49 (74%)	46%	6 (12%)	0.7 – 18.3	28%	40%

In a cross sectional study, Larsson, Hill, Odom-Maryon and Yu (2009), reported the results of radon testing in 1994 and 1998 in National Health Interview Surveys. Of the individuals who had heard of radon, a follow up question was given on whether their household air has been tested for radon. A total of 9.7% and 15.5% answered affirmatively (Larsson et al., 2009). In another study Nissen, Leach, Nessen, Swenson, and Kehn (2012), investigated the testing rate by patients instructed on radon in a primary care practice where patients had a radon testing rate at baseline of 24.7%. The high level of testing by the oncology nurses, prior to the REP, may demonstrate their interest in adopting protective behaviors around radon consistent with primary prevention. This result also aligns well with the hypothesis that oncology nurses will engage in behaviors from which they anticipate deriving personally valued benefits. This appears evident from the high testing rate at baseline and suggests this is a motivated group.

### **Phase II: Focus Groups**

In Phase II, three focus groups were conducted and audio taped. Data were captured using a transcript-based analysis. In alignment with an analysis methodology described by Krueger and Casey (2009), a classic analysis strategy guided identification of themes and categorized results. The analytical framework used key concepts. This framework was useful to understand how participants view a topic and identify important ideas, experiences, and preferences that illuminate the results.

The oncology nurses, within the Metro MN chapter of ONS, are a homogeneous population as compared to nurses that may choose to work in a primary care. Oncology nurses within ONS are voluntary members of this organization. Nurses who join ONS tend to be committed to oncology practice and to this specialized work. In addition, ONS has standards for patient care related to chemotherapy administration and side effect management. Therefore, this commitment to a specialized practice that has national standards of care may create a group of nurses with similar thoughts about practice related questions. These factors may have resulted in an easier path for focus group content analysis as similar ideas emerged within each focus group.

Evaluation of Phase II involved data analysis of the tapes transcribed from the focus groups. Content was analyzed for emerging themes related to participant recommendations for incorporating radon safety education into clinical practice. These recommendations for practice are important to advance the field in the area of primary prevention and the role of the oncology nurse. Five themes were identified.

**Theme one: Education.** The first theme related to education. Several focus group participants stated that they did not know much about radon prior to the educational inservice. They identified education of oncology nurses and physicians as important so health care professionals could be knowledgeable on the topic of radon and lung cancer when speaking with patients. This was identified as a challenge and described in this way: “Feeling that you can’t give a proper answer. Who wants to give an answer if they don’t know about it?” Another nurse engaged her colleagues on the topic of radon and, based on their responses, expressed concern about their knowledge level stating the first priority should address the “need to educate nurses and doctors first.” Another nurse stated that the data are “what impresses people.” A participant

commented on what she learned in the inservice as “I never knew that” and “nurses don’t understand it.”

**Theme two: Access.** The second theme identified was access to data and readily available information in the clinical setting. Data on radon and lung cancer should be easily accessible to oncology nurses and have contact information/websites and brochures available to educate patients and families. Nurses expressed that they have access to a library, but what they need are educational material such as brochures and teaching sheets. Other nurses shared that “getting this information out for oncology nurses is great.” and “if you have the brochures in the clinic then you can answer their questions.” The nurses also expressed that they should also have access to easily available information on how to test and mitigate your home. The nurses shared that this information was new to them and that it was important for all nurses to have readily accessible information.

**Theme three: Timing.** Another important theme related to the timing of patient education. Although the importance of educating patients was recognized, it was suggested that the timing of this education should be individualized to the patient. Some patients are open to receiving the information on radon after diagnosis or early on in treatment while others are overwhelmed with the new information. For some patients, education on radon may be best done later in the trajectory of the disease possibly in a survivorship clinic. One nurse described her patients initially feeling overwhelmed by the teaching on disease and treatment in this way:

There is usually a lot of information overload at first. But later down the line if someone is there for a week or two, which is often the case for some of these intensive treatments, it is a better time to talk to them.

**Theme four: The role of ONS.** The role of ONS in primary prevention was also clearly stated as another theme. Oncology Nursing Society involvement was recognized as important endorsement for this work. The society is well established with a large national membership. Several nurses agreed with the statement of one participant that “if you have the ONS backing this position then it gives it a little more credibility.” The nurses referred to ONS involvement, or at least endorsement, of educating patients on radon in clinical practice as important. Focus group members stated that ONS approval or involvement in this work was positive, but could also be strengthened by forming partnerships with community, primary care and other organizations. It was described in this way: “maybe partnering with the American Lung Association or the Breathe of Hope Lung Foundation. Those are other key organizations, also, I am sure, would have a similar endorsement of this.”

**Theme five: Barriers.** There were barriers identified to radon education in the clinical setting. The cost of mitigation for homes above the EPA action threshold was a concern. If a patient is unable afford to mitigate their home, it was viewed as a barrier to patients being interested in learning about radon testing and mitigation. One nurse stated that the patient may not want the information as they may be concerned that they have to move and that no one would buy the house. Other barriers to educating in the clinical setting included limited time and lack of knowledge on the topic as well as physician/clinic support.

### **Phase III: White Paper**

The oncology nurses who participated in the focus groups were informed that their input would be used in the development of a radon education document for clinical practice. This document was envisioned to be either a position paper or white paper. Definitions were provided for both types of documents during the focus group. The nurses suggested that that a document

that provided educational information and web links for additional resources would be most beneficial. It was apparent from the nurses' suggestions, that a white paper was the more appropriate format for providing education and information to the Metro MN Chapter of ONS (Appendix C). From the comments of the focus group participants, a prescriptive outline of data, information and references was developed. The white paper was adopted, without changes to format or content, by a unanimous vote by the Metro MN ONS board on September 10, 2013 and posted to the website. The membership was updated on the white paper on November 12, 2013 at their regular monthly meeting. Minnesota Department of Health supports radon educational outreach and reviewed the draft white paper with a few recommendations and no changes to the format.

### **Summary**

Implementation of REP identified that oncology nurses' knowledge of the exposure risk of radon to lung cancer was low and mirrored the general population. However, their testing rates were higher at baseline than other groups described in the literature. In addition, the majority (74%) of participants in the educational program also tested their homes with the test kit provided. This high rate of testing may account for nurses having a greater understanding of carcinogenesis and knowledge of the importance of general cancer prevention strategies compared to other groups. Oncology Nurses within the Metro MN ONS Chapter were also readily able to provide feedback in the focus groups on what is needed in the clinical setting to educate patients and families. Clearly education for health care practitioners and access to information was outlined as a priority going forward. The white paper addressed this information gap and provided links to appropriate resources with information on radon testing, mitigation and potential partner organizations.

## **Chapter 5**

This section will summarize the discussion of the findings and conclusions of the REP. In addition, recommendations for policy and dissemination of the REP to the broader community will be presented.

### **Discussion**

Results of the online survey and focus groups completed as a part of the Radon Education Project suggest that oncology nurses found the education on the association between radon exposure and lung cancer as highly relevant to them both personally and professionally. In follow up focus groups, they were able to identify programmatic and prescriptive strategies for incorporating primary prevention education on radon into clinical practice and to the broader community. Engaging oncology nurses in a primary prevention project on radon via an educational program and follow up focus groups yielded new insights for radon education.

Although many of the nurses who participated in the project had tested prior to the educational program, comments shared in the focus groups suggested that oncology nurses do not feel that their level of knowledge related to radon is sufficient to educate patients and families. They purposed that additional education is needed for health care professionals. Nurse participants also indicated that they need access to information and educational resources in the clinic setting to educate patients. Their self assessment that they have a knowledge deficit related to the topic of radon and need additional education highlights the challenge with radon education. The concept is difficult and is not well understood in the general population. This may have implications for more frequent or intensive educational programs.

The oncology nurses provided important information through their responses to the online survey and in the focus group discussions. Focus group feedback highlighted their belief



in the importance of the work, but that cost of mitigation was clearly a barrier. The work in oncology tertiary care does not engage primary prevention in everyday practice. This work, therefore, represents a paradigm shift in looking at ways to incorporate primary prevention strategies into clinical practice. In the era of health care reform the focus is on improving outcomes through disease prevention. Oncology nurses are a vital link to achieve this goal.

### **Recommendations**

#### **Future Work**

This project could serve as a model for addressing issues related to population health through collaboration between community organizations and the health care delivery system. According to the Institute of Medicine, health care delivery organizations and clinicians should partner with community-based organizations and public health agencies to leverage and coordinate prevention, health promotion, and community-based interventions to improve health outcomes (IOM, 2012). The model used in this project could be shared at a national ONS meeting with a long term goal of adoption in all ONS chapters across the United States.

#### **Public Policy**

Beyond education, appropriate legislation will ultimately change the incidence of radon induced lung cancer in Minnesota. A policy that would require testing and mitigating all homes above the EPA action level would reduce the mortality, morbidity and cost associated with radon induced lung cancer in Minnesota. Current legislation in Minnesota and other states focus on disclosure of the hazards of radon exposure during real estate transactions. Although this is a start, it does not meet the ultimate goal of testing all residential properties in Minnesota.

There are approximately 700 case of radon induced lung cancer in Minnesota each year with the majority of homeowners unsuspecting of the danger within their homes (Steck, 2010).

Since there is no safe level of radon, it is impossible to eliminate all risk. However, new policy that combined radon education with an anti-smoking message could be done with large scale testing. Health care organizations would need to be engaged in supporting this effort. Although a project of this magnitude would take several years to mitigate all homes above the EPA action level of 4 pCi/L, a gradual decline in lung cancer incidence would be expected over the subsequent 10 years.

The cost to treat one patient with lung cancer adds hundreds of thousands of dollars to health care expenditures while the available treatment has not significantly changed the outcomes for patients in decades. The morbidity and mortality to the patient, the pain to their families and the cost of care are important to consider. A partnership between the health care insurers and government may also help focus on prevention as expected of the health care system in this new era of healthcare reform.

### **Dissemination Activities Completed**

Considerable dissemination of the findings of the REP has already been accomplished through a variety of means and will be outlined in this section. In addition the inservice has been presented to several ONS chapters in Minnesota in 2013 with the goal to offer it to all state chapters by 2014.

### **Radon Education Project**

**Local chapters.** The Phase I (educational component) of the REP was presented at the Metro MN Chapter of ONS in April 2012. Oncology Nursing Society has four chapters in MN and the educational component was presented to two additional chapters thus far. The educational inservice was presented to the West Central Minnesota Chapter in Hutchinson, MN

in March, 2013 and to the Lake Superior Chapter in Duluth, MN in June 2013. The final chapter program is planned for Southeast Minnesota Chapter in Rochester, MN in February 2014.

**The white paper.** The final output of the REP was the development of a white paper on radon for the Metro MN Chapter of ONS. The white paper was presented to the Metro MN board in September 2013. The board voted to accept and place the white paper it for easy access on the Metro MN Chapter website also making this information available to other ONS members from the various chapters. The white paper was formatted to be readily applicable to educational needs that might arise in the clinical setting.

**Poster presentation at national ONS.** The REP was accepted as a poster presentation at the National Oncology Nursing Society Congress in Washington DC in April 2013. This provided an opportunity to share the project and findings with oncology nurses throughout the nation.

### **Radon Awareness Act**

**Newspaper column.** A MDH Omnibus policy bill that includes the Minnesota Radon Awareness Act was proposed in January 2013 by State Representative Carolyn Laine, DFL-Columbia Heights, MN. This legislative activity drew media attention to this subject and a representative at MDH Indoor Air Unit shared with reporters their collaboration with ONS through the REP. This author had several interviews with a reporter and a news column was printed in February 2013 in the local newspaper highlighting the REP.

Minnesota Department of Health Omnibus policy bill that includes the Minnesota Radon Awareness Act (2013) was passed by the Minnesota legislature and approved by Governor Dayton. Effective January 1, 2014, all residential home sales, including existing homes, new construction and high rises, in Minnesota will be required to conform to the MN Radon

Awareness Act. The new law dictates that before signing the purchase agreement, information about radon in the home must be disclosed and a “radon warning statement,” must be shared with the buyer.

This legislative activity drew media attention to this subject and a representative at MDH Indoor Air Unit shared with reporters their collaboration with ONS through the REP. Post telephone interviews with a reporter, a news column was printed in February 2013 in the local newspaper highlighting the REP.

**Scientific discussion.** A scientist from a Twin Cities medical device company read the newspaper article and contacted the author to learn more about REP. He expressed interest in developing a radon detector that could test for radon in real time. This change in technology could avoid the additional effort required by homeowners to send test kits to laboratories for analysis. If feasible and valid, this change in technology could benefit the general public by having radon results sooner and potentially improving compliance by homeowners to test and mitigate their homes. Since his team was not familiar with lung cancer, a presentation on lung cancer and radon along with additional information on REP objectives and the dissemination plan within the ONS chapters in Minnesota was provided to his scientific team in March, 2013. Although no future work is planned with his team at this time, they will potentially look into developing a radon detection device further in 2014.

### **Federal Radon Action Plan**

An educational forum for health care professionals and department of health employees was held at a health care facility in northern Minnesota hosted by MDH in June 2013. Information on the educational inservice on radon to oncology nurses and findings of the REP

were presented. Networking opportunities allowed for further discussion on radon population risk reduction with an advocacy member of CanSAR (Cancer Survivors against Radon).

This discussion led to follow up emails and an invitation to join the leadership committee of the Federal Radon Action Plan in October, 2013. This “breakthrough event,” located in Washington DC, was a collaboration of Federal agency leadership and nongovernmental organizations (NGO) to develop a coordinated national strategy for eliminating preventable lung cancer from radon. The objectives of the one day meeting were to:

- Learn what federal agencies are currently doing to find and fix high radon levels in government-influenced homes and schools through the Federal Radon Action Plan.
- Develop the blueprint for a multi-sector, nationwide coordinated radon risk reduction campaign.
- Explore ways to leverage and amplify federal activity to achieve greater public health impact.
- Engage federal and NGO colleagues to write the strategy for rapid, lifesaving public health action.

In the afternoon session, the topic of discussion was on new strategies for reducing radon induced lung cancer deaths. Small groups were formed to discuss potential new areas in radon testing and mitigation. The REP was represented in the group with members of the National Association of County and City Health Officials (NACCHO), and representatives of the Children’s Environmental Health Network, CanSAR and the Dusty Joy Foundation, a nonprofit lung cancer advocacy group. Group members embraced the idea of working with health care practitioners, especially oncology nurses and including radon awareness education into smoking cessation programs.

### **Conclusion**

The REP was the first documented collaboration of oncology nurses and the MDH in educating oncology nurses on radon and lung cancer and identifying potential ways to educate patients in clinical practice. As hypothesized, oncology nurses embraced the education and found the information to be highly relevant to them personally and professionally. Compared to the literature, the nurses that participated in the educational inservice had a higher percentage of testing their homes at baseline than seen in the general public. This higher than expected level of testing prior to the education program, possibly relates to their understanding of the health hazard related to radon. However, in follow up focus groups, nurses identified a knowledge deficit related to radon in themselves, their colleagues and physicians. So despite their recognition of the hazards of radon, their overall knowledge of radon risk to develop lung cancer is limited and mirrors the general population.

In the era of health care reform, the need to focus on cost of care and prevention of disease is desperately needed. Oncology nurses have a unique perspective on cancer and could be one entry point for a systematic and organized educational process on radon education in clinical practice. The departments of health and clinical practice settings have functioned independently when they clearly have an interdependent function in fostering the health of our nation. The Institute of Medicine clearly defines the initiative to collaborate (IOM, 2012). This greater utilization of combined resources may be what is needed in radon education in the future.

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**Appendix A****Radon Education Program  
INFORMATION AND CONSENT FORM****Introduction:**

You are invited to participate in a research study investigating oncology nurses evaluation of a radon education program and evaluation of radon testing and mitigation by participants following the program. This study is being conducted by Maureen Quick, a graduate student at St. Catherine University under the supervision of Roberta Hunt PhD, MSPH, RN, a faculty member in the Department of Nursing. You were selected as a possible participant in this research because you are a member of the Metro MN Chapter of ONS. Please read this form and ask questions before you agree to be in the study.

**Background Information:**

The purpose of this study is engage oncology nurses through the Metro MN Chapter of the Oncology Nursing Society (ONS) in a primary prevention program on radon education.

**Aim 1:**

To increase knowledge of the association between radon exposure and lung cancer as demonstrated by Survey Monkey responses and an increase in radon testing and mitigation by participants

**Aim 2:**

To identify the relevance to clinical practice in follow up focus group(s) through the development of a position paper.

Approximately 70 people are expected to participate in this research.

**Procedures:**

If you decide to participate, you will be asked to complete the following steps. The time interval for the study will include the program session on April 10, 2012 and a follow up of a Survey Monkey within a couple of weeks of the program.

1. During program registration at the April 10, 2012 meeting of the Metro MN ONS, the PI will discuss the study and provide the consent forms. Participants who wish to participate in the study will sign the consent form and return it to the PI. Study participants will then be asked to provide contact information on the "Contact Information for Study Participation" form for a follow up Survey Monkey. (This may take approximately 15 minutes)
2. A power point presentation on radon education will be presented. Components of the program will include: radon risk to develop lung cancer, health disparity within certain populations to develop lung cancer, radon testing and mitigation. (60 minute program)
3. At the completion of the program, study participants will complete an evaluation of the program (This may take 5-10 minutes to complete)
4. Radon test kits will be offered at the conclusion of the program
5. A follow up Survey Monkey will be sent via email to study participants. (This survey is 10 questions and may take approximately 20 minutes to complete)

6. From the population in attendance, the opportunity to participate in a follow up focus group will be offered. Interest in advanced practice nurses and nurses working with lung cancer patients from multiple centers within the metro area will be selected from the list of subjects willing to participate in a follow up focus group.

**Risks and Benefits of being in the study:**

The study has the following minimal risks outlined below.

1. The time commitment to participate in program evaluation and radon testing. Total time commitment may be up to 3 hours of time.
2. The potential concern over radon exposure. The program will contain information on the association of radon to lung cancer risk. This may result in feelings of discomfort. This risk is low since the study draws from participants who are aware of the content of the program.
3. There is a direct benefit to participation in the study in that you will be aware of the level of radon in your home and if the level is high, you can mitigate your home to reduce your risk to develop lung cancer.

**Confidentiality:**

Any information obtained in connection with this research study that can be identified with you will be disclosed only with your permission; your results will be kept confidential. In any written reports or publications, no one will be identified or identifiable and only group data will be presented. All information will be maintained by the PI and will not be disclosed without your written permission.

I will keep the research results in a locked file cabinet in my home and only I and my advisor will have access to the records while I work on this project. I will finish analyzing the data by December 2013. Data will be kept for a minimum of 5 years. Data that contains the identity of participants will be destroyed on June 1, 2017.

**Voluntary nature of the study:**

Participation in this research study is voluntary. Your decision whether or not to participate will not affect your future relations with Metro MN ONS or St. Catherine University in any way. If you decide to participate, you are free to stop at any time without affecting these relationships.

**Contacts and questions:**

If you have any questions, please feel free to contact me, Maureen Quick, at 612-840-6010. You may ask questions now, or if you have any additional questions later, the faculty advisor, Roberta Hunt PhD, MSPH, RN can be reached at 651-690-6851, and will be happy to answer them. If you have other questions or concerns regarding the study and would like to talk to someone other than the researcher(s), you may also contact Dr. John Fleming, Acting Chair of St. Catherine University Institutional Review Board, at (651) 690-6951.

You may request a copy of this form for your records.

**Statement of Consent:**

You are making a decision whether or not to participate. Your signature indicates that you have read this information and your questions have been answered. Even after signing this form, please know that you may withdraw from the study at any time.

---

I consent to participate in the study.

---

Signature of Participant

Date

---

Signature of Researcher

Date

**Appendix B****Engaging Oncology Nurses in a Primary Prevention Project on Radon: Outcome Analysis and Implications for Practice (Title of research)****INFORMATION AND CONSENT FORM****Introduction:**

You are invited to participate in a research study that explores how oncology nurses through the Metro MN Chapter of the Oncology Nursing Society (ONS) might be involved in the development of a primary prevention project on radon. This study is being conducted by Maureen Quick, a graduate student at St. Catherine University under the supervision of Roberta Hunt PhD, MSPH, RN, a faculty member in the Department of Nursing. You were selected as a possible participant in this research because you are a member of Metro MN ONS and you attended the April 10, 2012 Metro MN ONS continuing education program on radon and lung cancer. Please read this form and ask questions before you agree to be in the study.

**Background Information:**

The purpose of this study is to engage oncology nurses through the Metro MN Chapter of the Oncology Nursing Society (ONS) in a primary prevention project on radon. This study will identify how primary prevention strategies related to radon exposure can be incorporated into oncology clinical practice as recommended by participants in a radon education follow up focus group(s). Focus group participant feedback and recommendations will then be incorporated into a position paper. The final output for this project is to develop a white paper or position statement for the Metro MN Chapter of the Oncology Nursing Society

**Procedures:**

If you decide to participate, you will be asked to

7. Prior to the focus group, the PI will discuss the study and provide the consent forms. Participants who wish to participate in the study will sign the consent form and return it to the PI.
8. A brief review of the April 2012 radon educational program will be highlighted.
9. Several questions will be asked for your feedback related to radon education in oncology clinical practice
10. Your feedback will be recorded by audio tape. The feedback will be confidential and your individual responses will remain anonymous to anyone outside of the PI and advisor.

**Risks and Benefits of being in the study:**

The study has the following minimal risks outlined below.

4. The time commitment to participate in program evaluation and radon testing. Total time commitment will be approximately 1 hour.
5. The focus group will discuss the association of radon to lung cancer risk. This may result in feelings of discomfort. This risk is low since the study draws from participants who are aware of the content of the program.

6. There are no direct benefits to you for participating in this research.

**Confidentiality:**

Any information obtained in connection with this research study that can be identified with you will be disclosed only with your permission; your results will be kept confidential. In any written reports or publications, no one will be identified or identifiable and only group data will be presented. All information will be maintained by the PI and will not be disclosed without your written permission.

The researcher will keep the results in a locked file cabinet in my home and only I and my advisor will have access to the records while I work on this project. I will finish analyzing the data by December 2013. Data will be kept for a minimum of 5 years. Data that contains the identity of participants will be destroyed on June 1, 2017.

**Voluntary nature of the study:**

Participation in this research study is voluntary. Your decision whether or not to participate will not affect your future relations with Metro MN ONS, Minnesota Department of Health or St. Catherine University in any way. If you decide to participate, you are free to stop at any time without affecting these relationships.

**Contacts and questions:**

If you have any questions, please feel free to contact me, Maureen Quick, at 612-840-6010. You may ask questions now, or if you have any additional questions later, the faculty advisor, Roberta Hunt PhD, MSPH, RN can be reached at 651-690-6851, and will be happy to answer them. If you have other questions or concerns regarding the study and would like to talk to someone other than the researcher(s), you may also contact Dr. John Schmitt, Chair of the St. Catherine University Institutional Review Board, at (651) 690-7739.

You may keep a copy of this form for your records.

**Statement of Consent:**

You are making a decision whether or not to participate. Your signature indicates that you have read this information and your questions have been answered. Even after signing this form, please know that you may withdraw from the study at any time.

---

I consent to participate in the study and I agree to be audio taped.

---

Signature of Participant

Date

---

Signature of Researcher

Date

**Appendix C**

# Radon and Lung Cancer: Information and Resources for Use in Oncology Clinical Practice

September 10, 2013

Maureen Quick RN, MS, OCN  
Doctoral Candidate, St. Catherine University  
Metro MN ONS Member

*"I don't know if it is a community or state or federal requirement or if it is just widely considered best practice. The radon thing could be, at least in MN, considered best practice to be addressed by all health care providers.*

Focus Group Participant, Metro MN Member, 2012

*"Lung cancer due to radon is a preventable disease. Our mission should be that we disseminate information about that."*

Focus Group Participant, Metro MN Member, 2012

*I think it is great that we as a chapter have something specific that we sort of stand for or have a goal for or can present as part of as to why we are in existence*

Focus Group Participant, Metro MN Member, 2012

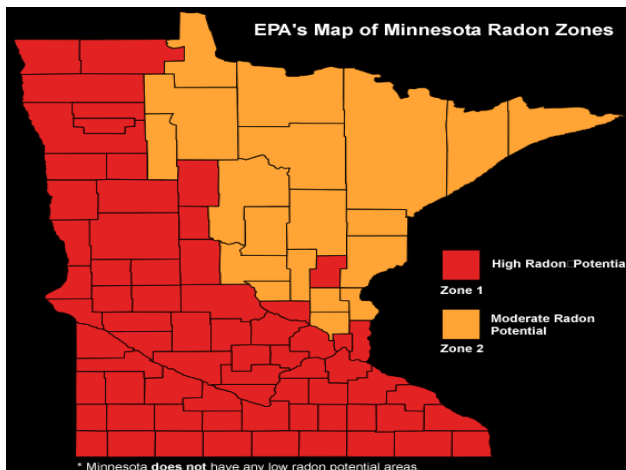


## Introduction

The Radon Education Project (REP) included the development of a process to educate, create interest and develop recommendations for primary prevention strategies related to radon for oncology nurses in the Metro MN Chapter of the ONS. This white paper was developed based on input from Metro MN Chapter members who participated in the REP focus groups.

## Background

- Radon is a naturally occurring gas produced from the decay of uranium that is found in nearly all soil (MDH, 2010)<sup>1</sup>
- Radon flows from the soil into the air. Outside air typically has low concentrations; however, radon gas can also seep into homes where it is unable to disperse. This build up of radon gas within the home can then lead to higher concentrations. (National Research Council, 1999)<sup>2</sup>
- Radon is chemically inert. However, the radon atoms can spontaneously decay or change into other atoms called radon progeny. The radon progeny are electrically charged and can attach themselves to small dust particles. The dust particles can easily be inhaled into the lung.
- The deposited atoms emit alpha radiation that can disrupt DNA of the lung cells leading to one step in the development of lung cancer (National Research Council, 1999)<sup>2</sup>
- The map below shows average radon levels in the state



Zone 1 counties have a predicted average indoor radon screening level greater than 4 pCi/L (picocuries per liter) (red zones)<sup>3\*</sup>

Zone 2 counties have a predicted average indoor radon screening level between 2 and 4 pCi/L (orange zones)<sup>3</sup>

Zone 3 counties have a predicted average indoor radon screening level less than 2 pCi/L (yellow zones)<sup>3</sup>

\*Environmental Protection Agency (EPA) recommends that all homes with radon levels of 4 pCi/L or more be mitigated.

## Significance

*Radon gas is the second leading cause of lung cancer in the U.S. with an estimated 21,000 deaths per year<sup>3</sup>*

- Approximately 15% of all lung cancers are attributable to indoor radon.
- Leading cause of lung cancer for non-smokers
- The combined effect of smoking and radon exposure is synergistic; therefore at equivalent exposure to radon, smokers will have a higher risk of developing lung cancer than non smokers<sup>4</sup>
- Environmental Protection Agency (EPA) recommends that all homes with radon levels of 4 pCi/L or more be mitigated
- Comparable risk at 4 pCi/L is 200 chest x-rays per year<sup>3</sup>
- Death risk to the average person from radon gas at home is 1,000 times higher than the risk from any other carcinogen or toxin regulated by the FDA or EPA<sup>3</sup>

*There is no known safe level of radon*

## Radon in Minnesota

Since radon gas is clear and odorless, individuals may be unaware of their exposure to this harmful gas.

Nationally elevated radon levels are in approximately one in 15 homes (US Environmental Protection Agency, 2013).

Nearly 80% of counties are rated high radon zones<sup>3</sup>

The Minnesota Department of Health (MDH) recommends that all Minnesota homeowners test their home for radon<sup>2</sup>

The radon test kit costs between \$5-\$25 and radon mitigation costs approximately \$800-\$2500<sup>2</sup>

*Due to the geology and how homes are built and operate in Minnesota, two in five homes have radon levels above the EPA action level of 4 pCi/L (MDH, 2010).*

## How can Oncology Nurses and other Health Care Professionals Help?

1. **Education of oncology nurses and physicians:** This document contains basic information on the health hazard associated with radon. Resources below also provide additional information for use in educating professionals so they feel confident in teaching patients/family members.
2. **Patient Assessment Form/Intake:** Patients complete a personal health assessment questionnaire/intake form. Consider asking them if they have ever tested their home for radon or do they know what the radon level of their home. If added to the form, it may provide an avenue for them to ask questions
3. **Access to data and information for patients:** Information should be available to educate patients and families
  - a. Add radon brochures from MDH to the clinic information center, patient resource center or patient library.
  - b. Provide an information board in the lobby. Consider picking a topic for the board for a month. This may generate patient questions. January is radon action month and November is lung cancer awareness month.
  - c. Consider the timing of education. Some patients would be open to receiving the information on radon immediately and others would be overwhelmed with the new information. This education should be individualized and education on radon may be best in a survivorship clinic.
  - d. Topic of discussion or informational booth at support group, survivorship conference or volunteer activity
  - e. Consider ways to enhance community involvement and primary care involvement
  - f. MDH also recommends having bookmarks and test kit order forms available and to utilize the Star Tribune portal to provide zip code data to the community [www.startribune.com/local/190554621.html](http://www.startribune.com/local/190554621.html)
  - g. Consider using one of the MDH radon posters for your information board <http://www.health.state.mn.us/divs/eh/indoorair/radon/sirg.html>

## Benefits of Oncology Nursing Society (ONS) Involvement

- Organization promotes awareness and teaching. Metro MN ONS endorsing and promoting this work would provide credibility
- Information is relevant to health care providers both personally and professionally

## Resources/Websites

1. Minnesota Department of Health: Radon in MN homes. The primary portal for radon in MN: [www.health.state.mn.us/radon](http://www.health.state.mn.us/radon)
2. Minnesota Department of Health: Resources for Medical Providers <http://www.health.state.mn.us/divs/eh/indoorair/radon/medical.html>
3. A Breath of Hope Lung Foundation: <http://www.abreathofhope.org/>

## PRIMARY PREVENTION PROGRAM ON RADON

4. CanSAR: Cancer Survivors Against Radon: <http://www.cansar.org/>

### Test Kits and Brochures

1. Radon Testing Procedure and information: [www.health.state.mn.us/radon](http://www.health.state.mn.us/radon) (pick radon testing or radon test kits)
2. Minnesota Department of Health: Radon Brochure has information on radon testing and mitigation. available on-line, also as a pdf, and hard copy can be ordered (for free from MDH, as supplies last). A shorter bookmark is also available for mass distribution: [www.health.state.mn.us/radon](http://www.health.state.mn.us/radon)

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### Acknowledgement

Author, MH Quick, would like to thank the Minnesota Department of Health (MDH) for their contributions to this Systems Change Project on radon and lung cancer.

This is the first work demonstrating oncology nurses partnering with the Minnesota Department of Health in a formalized programmatic approach on radon safety education.